

# INSTRUCTION MANUAL

for

## ONAN ELECTRIC GENERATING PLANTS

•  
**1B**

*Series*

•  
Direct Current Models

•  
Alternating Current Models

**D. W. ONAN & SONS INC.**

MINNEAPOLIS 14, MINNESOTA

901-25 ▲

*Price \$1.00*

Printed in U.S.A.



# GENERAL INFORMATION

**THE PURPOSE OF THIS BOOK.** This instruction book is furnished so that the operator may learn of the characteristics of the plant. A thorough study of the book will help the operator to keep the plant in good operating condition so that it will give efficient service. An understanding of the plant will also assist the operator in determining the cause of trouble if it occurs.

**KEEP THIS BOOK HANDY.** Such simple mistakes as the use of improper oil, improper fuel, or the neglect of routine servicing may result in failure of the plant at a time when it is urgently needed. It is suggested that this book be kept near the plant so that it may be referred to when necessary.

**SERVICE.** If trouble occurs and the operator is unable to determine the cause after a thorough study of this book, or if he is unable to determine what repair parts are required, needed information will be furnished upon request. **WHEN ASKING FOR INFORMATION, BE SURE TO STATE THE MODEL, SPEC., AND SERIAL NUMBERS OF THE PLANT. THIS INFORMATION IS ABSOLUTELY NECESSARY AND MAY BE OBTAINED FROM THE NAMEPLATE ON THE PLANT.**

## MANUFACTURER'S WARRANTY

The manufacturer warrants each new engine or electric plant to be free from defects in material and workmanship. Under normal use and service our obligation under this warranty is limited to the furnishing of any part without charge which, within ninety (90) days after delivery to the original user shall be returned to us or our authorized service station with transportation charges prepaid and which our examination shall disclose to have been defective.

Our liability in case of defective workmanship, material or any costs incurred in remedying any claimed defective condition in any unit or such unit having been repaired, altered or which installation and service recommendations have not been complied with, is limited strictly to the proper adjustment authorized by the factory.

This warranty does not include or cover standard accessories used, such as carburetors, magnetos, fuel pumps, etc., made by other manufacturers. Such accessories have separate warranties made by the respective manufacturers. Repair or exchange of such accessories will be made by us on the basis of such warranties.

This warranty is in lieu of all other warranties expressed or implied.

### IMPORTANT

RETURN WARRANTY CARD ATTACHED TO UNIT.

# TABLE OF CONTENTS

SUBJECT	PAGE NO.
Description	
General .....	1
Engine - Generator .....	2
Controls - Accessories .....	3
Installation	
Indoor Installation .....	5
Mobile Installation .....	5
Underground Exhaust .....	5
Mounting - Fuel Reservoir Tank .....	7
Underground Fuel Tank .....	8
Grounding - Batteries - Wiring .....	8
Connecting the Load .....	8
Remote Control Connections .....	9
Remote Stop Switch, Battery Charging Plant .....	10
Preparation	
Lubrication - Fuel .....	11
Operation	
Starting .....	12
Adjusting Charging Rate .....	13
When to Operate .....	13
Gas Operation .....	13
Abnormal Operating Conditions	
Cold Temperatures - Hot Temperatures .....	16
Dust and Dirt .....	16
Automatic Choke .....	16
Periodic Service	
Daily - Weekly .....	19
Monthly - Semi-Yearly .....	20
Accessory Service	
Carburetor - Automatic Choke .....	23
Fuel Pump - Governor .....	23
Hunting Prevention - Spark Plug .....	24
Fuel Pump - Oil Pump .....	24
Maintenance and Repair	
Engine .....	25
Table of Clearances .....	30
Generator .....	30
Controls .....	31
Service Diagnosis	
Possible Cause - Remedy .....	32
Wiring Diagrams	
AC Remote Control .....	38
AC Manual Start .....	39
115 Volt DC Manual Start .....	40
32 Volt DC Remote Control .....	41
32 Volt DC Electric Start .....	42

## LIST OF ILLUSTRATIONS

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SUBJECT	PAGE NO.
Typical 1B Series Plant .....	4
Typical Installation .....	6
Mounting .....	7
Day Tank Installation .....	7
Remote Control Connections .....	9
Vapor Fuel Attachment .....	15
Lubrication .....	18
Accessory Service .....	22
Automatic Choke Adjustment .....	23
Maintenance and Repair .....	26
Wiring Diagrams	
AC Remote Control .....	38
AC Manual Start .....	39
115 Volt DC Manual Start .....	40
32 Volt DC Remote Control .....	41
32 Volt DC Electric Start .....	42
Cross Section .....	43

# Important !

*Always* GIVE THESE NUMBERS  
WHEN ORDERING REPAIR PARTS OR  
REQUESTING SERVICE INFORMATION  
FOR YOUR UNIT !  
WRITE IN NUMBERS SHOWN ON PLANT NAMEPLATE

MODEL & SPEC. NO.

SERIAL NO.

ELECTRIC		PLAN	
MODEL AND SPEC. NO.		SERIAL NO.	
IMPORTANT			
A.C. VOLTS	1	500	WATTS
F.F.	AMPS	5	PHASE
D.C. VOLTS	100	WATTS	
SER. NO.	100	REMARKS TO	
R.F.D.	USE	JOINT BATTERY	
D. W. GRAY & SONS, INC.			
MINNEAPOLIS, MINNESOTA, U.S.A.			

## GENERAL

The power units to which this manual applies are complete electric generating plants. Each plant includes an engine, generator, and necessary accessories. Each plant is thoroughly tested before leaving the factory to assure that all parts are in good condition and that each plant will produce its rated output. Inspect the plant when received. Damaged parts must be repaired or replaced.

This manual is supplied to assist the operator in installing and operating the plant and in maintaining it so that it will provide maximum service at minimum cost. One copy of this manual is supplied with each plant.

The 60 cycle alternating current plants operate at approximately 1800 r.p.m. and the 50 cycle alternating current plants operate at approximately 1500 r.p.m.

**AC MANUAL PLANTS.** - Plants of the manual start type can be started by hand cranking only. Electricity is supplied directly to the load from the generator, and the plant must be operated whenever electricity is being used.

**AC REMOTE CONTROL PLANTS.** - Plants of the remote control type may be started either electrically or manually. A 12-volt battery (two 6-volt batteries in series) must be properly connected to the plant to furnish cranking power when starting the plant electrically. Electricity is supplied directly to the load from the generator and the plant must be operated whenever electricity is being used.

## DC BATTERY CHARGING PLANTS

This type of plant is operated to generate electricity which is supplied directly to the storage battery. Electricity may be used while the plant is running or, as limited by the charge in the battery, while the plant is not running. **NEVER OPERATE THIS TYPE OF PLANT WITHOUT HAVING THE BATTERY CONNECTED.**

## DIRECT SERVICE PLANTS

This type of plant must be operated whenever electricity is used.

## DC ELECTRIC START PLANTS

Plants of the electric start type may be started electrically at the plant control box only. They may also be started manually.

### ENGINE

The engine is a one cylinder, upright, four cycle, air cooled, gasoline burning engine. The engine speed of some models is regulated by a hand controlled throttle. Other models are controlled by a centrifugal weight type, gear driven governor. A high tension flywheel type magneto supplies the ignition current. The ignition system is shielded to reduce radio interference. The engine is cooled by air being drawn in through the blower housing and forced out around the cylinder and over the cylinder head and other areas by a centrifugal type blower. The plunger type oil pump operates off an eccentric on the camshaft and forces oil to the main bearings and the connecting rod. All other internal working parts are spray lubricated.

The bore of the engine is 2-3/4"; the stroke is 2-3/4"; compression ratio 4.8 to 1; horsepower at 1800 RPM 2.5 and horsepower at 2450 RPM 3.25. The cylinder and the oil base are removable from the crankcase. The piston is aluminum alloy and is the 4-ring type, with a full floating piston pin. Three compression rings and one oil control ring form the ring group. The exhaust valve seat insert is replaceable. The valves are of special steel alloy.

The main and camshaft bearings are of the sleeve type, steel backed and babbitt lined. No bearing inserts are used in the aluminum alloy connecting rod.

### DC GENERATOR

The air cooled generator is of the four pole, direct current type. The battery charging plants are shunt wound with an inherent taper characteristic, having a series winding for cranking purposes only. The direct service plant generators are compound wound. The armature is connected directly to the crankshaft by a male and female taper. It is held in place by a draw stud that passes through the armature shaft from the crankshaft. A nut and washer at the outer end hold the armature securely. The outboard end of the armature shaft is supported by a ball bearing on the 1500 watt battery charging units.

### AC GENERATOR

The air cooled generator is of the four pole, alternating current, revolving armature type. The a c and the d c windings of the armature are wound on the same laminations, the a c windings connecting to the collector rings, and the d c windings to the commutator. Both types of plants have saturated shunt field windings, the remote control plants having a series winding in addition for cranking purposes. The armature is directly connected to the crankshaft and turns at engine speed. The armature of the 1000 watt plant is supported at the inner end by the rear crankshaft bearing and at the outer end by a ball bearing. The



armature of the 500 watt plants is supported by the rear crankshaft bearing. The frame is a rolled steel ring, machined on the inside, in which the pole pieces and coils are mounted.

### AC CONTROLS

**MANUAL PLANTS.** - The controls for the 500 watt manual plants consist of a manually operated choke and a stop button. The 1000 watt manual plant has an automatic choke.

**REMOTE CONTROL PLANTS.** - The remote control plants are equipped with a control box containing the necessary controls for starting the plant electrically and for controlling the charging rate to the starting battery.

### DC CONTROLS

Battery charging plants may be cranked either electrically or manually. A control box atop the generator mounts a start switch, stop switch, a reverse current relay, ammeter and 50 ampere main fuse.

Direct service plants are cranked manually with the starting rope. A receptacle box is mounted on the side of the generator. All plants have hand operated chokes and a conveniently located stop button.

### ACCESSORIES

Standard accessories for Battery Charging Units include a cranking rope, a set of mounting cushions, flexible exhaust tubing and fittings, muffler, oil drain extension, and an instruction manual.

Standard accessories for Direct Service units include a cranking rope, set of rubber mounting cushions, oil drain extension, muffler and an instruction manual.

Standard accessories for alternating current units include a cranking rope, set of mounting rubbers, exhaust muffler, and an instruction manual.

### SPECIAL ACCESSORIES

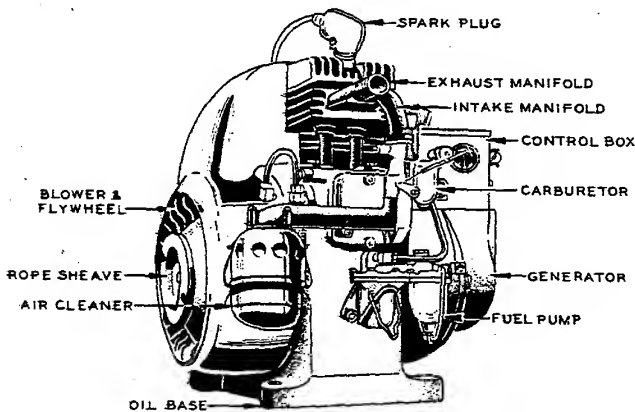
The following special accessories are not standard equipment but are available at extra cost. See the dealer for details. Be sure to state the Model and Serial numbers of the plant when ordering.

**DOLLIES.** - Standard dollies are of sturdy, lightweight, all steel construction. Special rubber tired dollies designed to carry the starting battery and fuel tank are also available.

**BUTANE, PROPANE, NATURAL GAS ATTACHMENTS.** - Carburetor kits are available for operating the plant on Butane, Propane, or natural gas.

**AUTOMATIC CONTROLS (REMOTE CONTROL PLANTS ONLY).** - A separate control panel is available for automatically starting and stopping the plant. A 60 watt lamp load (or its equivalent) on any branch of the circuit starts the plant. When the last load is switched off, the plant stops.

This manual contains no information about automatic controls. Write to the factory and give the plant MODEL, SPEC. NO., & SERIAL NO. for an Automatic Control Manual.



Typical 1B Series Plant

**IMPORTANCE OF PROPER INSTALLATION.** - It is important that the plant be properly installed to give good service. It may be operated outdoors, but rain, snow, dust, dirt, and grit are unfavorable to satisfactory operation. If practicable, install the plant in a building or inside a mobile vehicle.

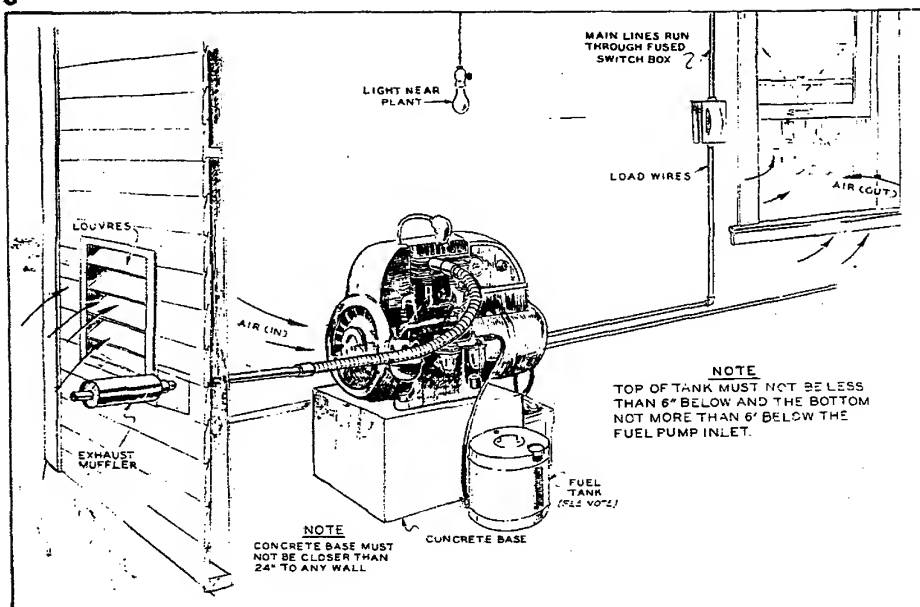
### CAUTION

Proper ventilation must be provided. Exhaust gases are poisonous. Excessive inhalation will cause severe sickness or death. Do not operate the plant in a building or other confined space without piping all exhaust gases out doors.

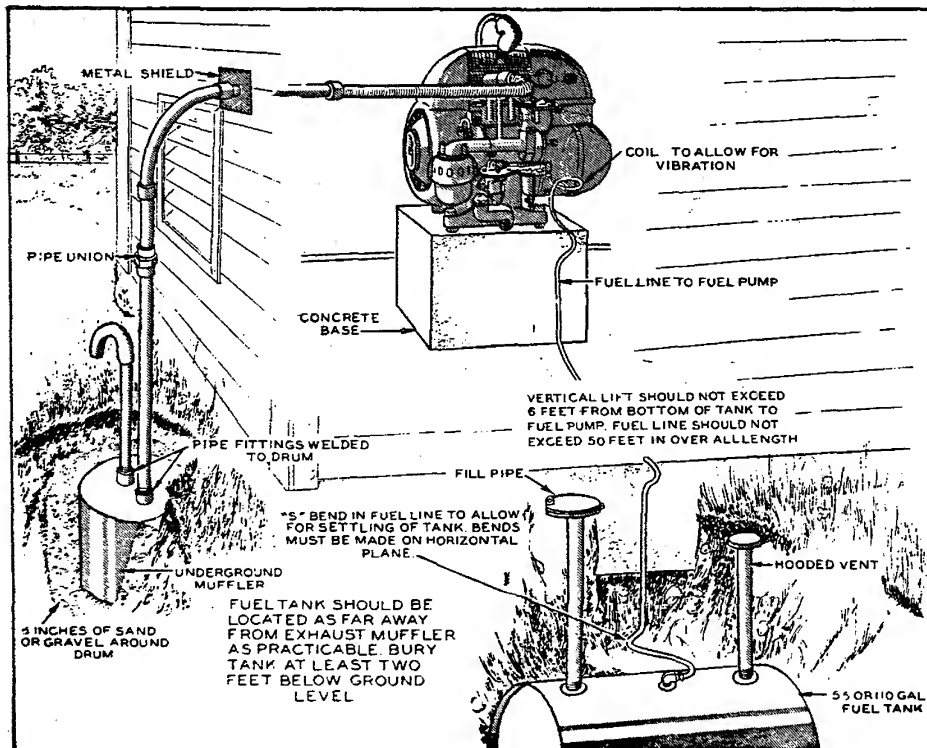
**INDOOR STATIONARY INSTALLATION.** - The location selected should be as near the electrical center of the load as practicable. The room should be clean, dry, well ventilated, and if necessary, heated in very cold weather. Mount the plant securely to either a timber or concrete base in such position that it will set level when operating. Locate it so as to provide proper ventilation and space for servicing. There must be an air inlet and outlet, each at least 18" x 18" in area, for proper ventilation. Pipe the exhaust gases outside the building with pipe as large as the exhaust outlet of the plant. Connect one end of the flexible tubing to the exhaust outlet of the plant, and the other end of the flexible tubing to the exhaust pipe that conducts exhaust gases out of the building. Connect the muffler to the end of this pipe, outside the building. See illustration. Keep the exhaust pipe at least several inches away from inflammable material. If the exhaust line must be pitched upward, construct a condensation trap of pipe fittings and install at the point where the upward pitch begins.

**MOBILE INSTALLATION.** - Follow generally the instructions for indoor installation, taking care to provide ample ventilation if the vehicle is a closed one.

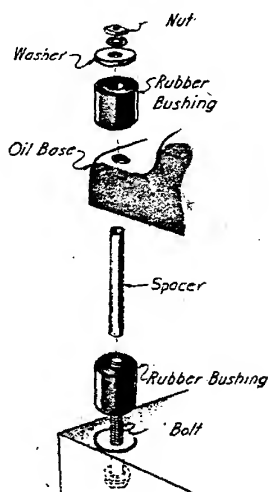
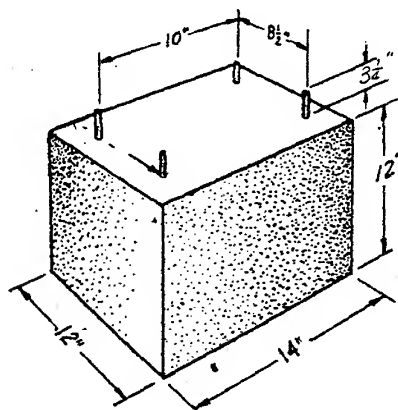
**UNDERGROUND EXHAUST INSTALLATION.** - If so desired, an underground exhaust chamber may be used instead of a muffler. However, if there is danger of the chamber filling with water at any time it cannot be used. A heavy 15 or 30 gallon drum may be used. Never use a drum that previously contained gasoline, turpentine, or similar liquids, as an explosion may result. Remove the bottom from the drum. Weld a one inch, or larger, fitting on the drum for each inlet and outlet and connect the inlet and outlet pipes. Dig a pit which is at least six inches larger on all sides than the drum. Fill the bottom of the pit with loose sand or gravel. Then make a pile of large rocks the approximate size of the drum used, set the drum down over these rocks, and fill in around the drum with loose sand or gravel. See illustration. The outlet pipe should be at least 24 inches above ground with a gooseneck fitting on the end. The inlet pipe must be shielded where it passes through the wall, the opening for the shields being at least 2 inches larger on all sides than the pipe.



## TYPICAL INSTALLATION -REMOTE CONTROL PLANT



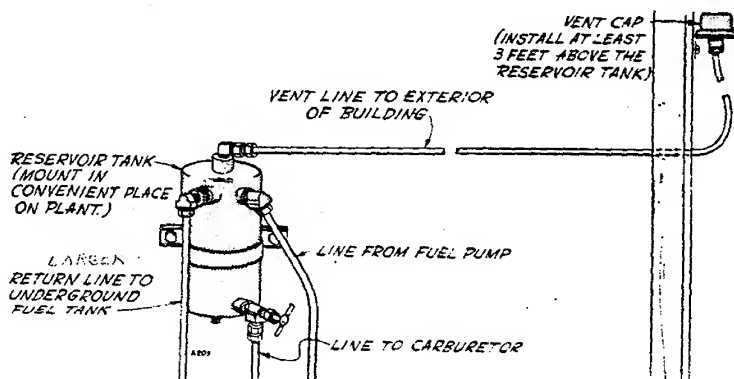
## UNDERGROUND MUFFLER AND FUEL TANK



Use the illustrated dimensions, and keep the base 24 inches from any wall. Build a wooden form into which the concrete can be poured and allowed to harden for 3 days. Mix one part cement, 2 parts sand, and 4 parts gravel. Pour the concrete and tamp down. Level the top, and embed the four 5/16 inch bolts to the proper depth. Re-level and smooth the top of the foundation.

The spacer bushings prevent excessive compression of the rubber cushions.

**FUEL RESERVOIR (DAY) TANK.** - Generating sets may stand idle for many days at a time. Enough gasoline may evaporate from the carburetor to lower the fuel level considerably. The installation of a gravity feed reservoir tank, as illustrated, will provide for quicker starting and is recommended for standby installations.



**DAY TANK INSTALLATION**

**UNDERGROUND FUEL TANK.** - Large fuel tanks in either 55 gallon or 110 gallon capacities are available at extra cost. Fuel lines in 25 and 50 foot lengths, with the necessary connectors, are also available. When ordering, please state the size tank and the length of fuel line desired. Check applicable codes before installing.

**GROUNDING THE PLANT.** - If grounding is called for in local codes, or radio interference necessitates it, drive a 1/2 inch pipe into the ground as close to the plant as practicable. This pipe must penetrate moist earth. Connect an approved ground clamp to this pipe and run a No. 10 or 12 wire from it to the negative battery terminal on the control panel or the M2 generator lead. Never connect this wire to a water pipe or to a ground used by radio system.

**BATTERIES.** - DC Installations will use a switch between batteries and unit. AC Installations connect battery directly to the control panel.

The installation and preparation of the batteries should follow closely the manufacturer's or supplier's recommendations. For DC Units connect the positive cable from the positive (+) post on the battery to the **BATTERY POSITIVE** terminal on the control panel through this switch, also connect the negative cable from the negative (-) post on the battery to the **BATTERY NEGATIVE** terminal on the control panel through this switch.

### CAUTION

Before servicing the engine, or generator, always disconnect the battery from the plant, by opening the switch to avoid accidental starting of the plant.

**WIRING.** - Use sufficiently large insulated wire to connect the plant to the load. The size will depend largely on the distance and permissible voltage drop between the plant and the load, and the amount and kind of load. Consult a competent electrician. Check national and local codes before installing. Install a circuit breaker or fused main switch in the load circuit near the plant and a fused switch between the starting battery and the plant.

**CONNECTING THE LOAD.** - (Battery Charging Plants). - Where main lines are used, connect the positive side of the main line to the **POSITIVE** terminal on the control panel, and the negative side to the **NEGATIVE** terminal on the control panel.

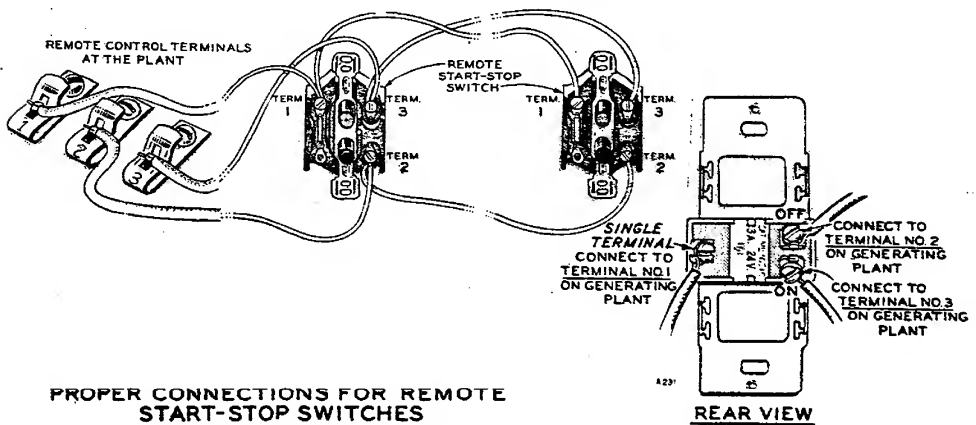
**CONNECTING THE LOAD - (Direct Service Plants) .** - After the plant has reached normal operating temperature, connect the load by inserting the receptacle plug of the main line wires into the receptacle mounted on the generator. Do not attempt to start the plant with a load connected.

**CONNECTING THE LOAD - (Manual Plants - AC).** - To connect the main line to the plant, install a suitable plug on the main line wires and plug into a receptacle on the generator. Electrical appliances of the proper voltage and phase may be connected directly at the receptacles, but the total demand in watts must not exceed the output of the generator.

**CONNECTING THE LOAD - (Remote Control Plants - AC).** - Connect the "hot" side of the main line (black wire) to the generator M1 lead, and the ground (white wire) side of the main line to the generator M2 lead. Use approved connectors and tape the connections properly.

## REMOTE CONTROL CONNECTIONS

Remote control start-stop stations may be installed at any point up to 630 feet from the plant. Use No. 18 wire up to 250 feet, No. 16 wire up to 400 feet, or No. 14 wire up to 630 feet. Make connections as shown in the following illustrations.



**REMOTE STOP SWITCH, BATTERY CHARGING PLANT**

To connect a remote stop switch, connect one wire between the Fahnestock clip inside the control box and one of the switch terminals. Connect a second wire between the second switch terminal and a good ground point on the plant. Additional switches may be connected in parallel, as desired.



**PREPARATION.** - Before the plant is put into operation it must be prepared with proper oil and fuel. Comply with the following instructions.

**LUBRICATION.** - Fill the crankcase to the level of the oil filler hole with 2-1/2 quarts of the proper SAE number oil according to the lowest temperature to which the plant will be exposed, as indicated in the following table. Keep the oil level at or near the top of the threads in the oil filler hole at all times.

TEMPERATURE	SAE NUMBER
Above 90°F. Above 32°C.	No. 40
Between 40°F. and 90°F. Between 5°C. and 32°C.	No. 30
Between 0°F. and 40°F. Between -18°C. and 5°C.	No. 10 or 10W
Below 0°F. Below -18°C.	No. 5W; or 10W diluted with 10% of kerosene

#### CAUTION

Do not put diluted oil into the crankcase until ready to start the engine. Mix well just before pouring into the crankcase.

#### NOTE

If the plant has been in storage, prime the oil pump. Refer to the OIL PUMP paragraph in the ACCESSORY section.

The use of a good detergent type oil in the engine crankcase greatly increases the life of pistons and piston rings. We strongly recommend its use.

If a change is made to detergent oil after using non-detergent oil in this plant, allow only 1/3 the normal operating hours before changing oil for each of the next two change periods. Change at the regular intervals thereafter.

**FUEL.** - Fill the tank nearly full with clean, fresh, "regular" grade of gasoline. Do not use a "premium" grade of gasoline, or any fuel with a high lead content. Engine life will be longer when gasoline containing the smallest amount of lead is used. NEVER FILL THE TANK WHEN THE ENGINE IS RUNNING.

**PRELIMINARY.** - Do not start the plant until it has been properly prepared for operation and the following instructions have been studied.

### CAUTION

If the preparation has been made for cold weather, the initial filling of the crankcase with diluted oil should have been left to be done immediately before starting the plant. Make sure the crankcase is filled with proper oil to the level of the oil filler hole.

**STARTING THE PLANT ELECTRICALLY.** - Before starting the plant for the first time make sure the fuel shut-off valve in the fuel tank is fully open. If the plant is equipped with a fuel pump, operate the primer lever on the fuel pump until the carburetor bowl is full of gasoline. **ON DC UNITS BE SURE THE SWITCH CONNECTING THE BATTERIES TO THE PLANT IS CLOSED.** Never start or operate the battery charging plant unless the batteries are connected to the plant. Some plants have an automatic choke; others are choked manually.

Pull the choke out all the way. Press the start button firmly for five to ten seconds, then release. If the plant fails to start, push the choke half way in and repeat the procedure. Do not press the start button continuously. Should the plant fail to start after several attempts, check the fuel and ignition systems, correct the trouble, and repeat the starting procedure. If the battery has become discharged to the point where it will not crank the plant, it must be started manually as described below.

### NOTE

Oil was sprayed into the cylinder before shipping and it may be necessary to remove and clean the spark plug in gasoline before the plant will start the first time. Be sure the plug is dry before reinstalling it.

**STARTING THE PLANT MANUALLY.** - Pull the choke out all the way. Wind the starting rope clockwise around the rope sheave at the front of the plant. Give a strong steady pull the full length of the rope. Should the plant fail to start, push the choke in as required and repeat the procedure. As the engine starts to fire, push the choke gradually in until it is fully open when the plant is thoroughly warmed up. Should the plant be stopped for a short time and is still warm when it is to be restarted, choking is not necessary. Over choking causes hard starting and excessive wear.

**ADJUSTING THE CHARGING RATE - DC UNITS.** - After the plant has been started, and the load is connected, adjust the amperage output of the generator to an amount slightly higher than is necessary to operate the connected load. The speed, and therefore the charging rate of the plant, is readily adjustable by changing the position of the manual controlled throttle arm. If a higher rate of charge is desired, move the throttle arm forward. Example: from 1 to 2; 2 to 3; 3 to 4. If a lower rate of charge is desired, move the throttle arm in the opposite direction.

**ADJUSTING THE CHARGING RATE - AC UNITS (Remote Control Plants).** - The charging rate to the starting battery may be adjusted by turning the knob on the rheostat to the right to increase the charging rate or to the left to decrease it. Usually a rate of 2 to 3 amperes will keep the battery in a charged condition. Do not exceed a constant charge rate of over 6 amperes.

When recharging the battery, check the specific gravity with a hydrometer at regular intervals. Refer to, and follow the battery manufacturer's or the supplier's instructions. Do not overcharge the battery.

### BATTERY CHARGING PLANTS

**WHEN TO OPERATE THE PLANT.** - This type of plant is operated to generate electricity which is supplied directly to the storage battery. The plant must be run to recharge the battery whenever it becomes discharged. Electricity may be used while the plant is running or, as limited by the charge in the battery, while the plant is not running. **DO NOT OPERATE THE PLANT WITHOUT HAVING THE BATTERY CONNECTED.**

### ALTERNATING CURRENT - DIRECT SERVICE PLANTS

**WHEN TO OPERATE THE PLANT.** - This type of plant must be operated whenever electricity is used.

**STOPPING THE PLANT.** - Press the stop button firmly until the engine has completely stopped.

### INSTRUCTIONS FOR OPERATING PLANTS EQUIPPED FOR NATURAL, BUTANE, OR PROPANE GAS OPERATION

Follow the national and local codes on installing fuel pipes and fuel containers, depending on the type of fuel being used. Make the necessary connections and proceed as follows:

**CAUTION**

Make sure the line pressure of the gas as supplied to the regulator on the plant does not exceed six ounces per square inch. If the pressure exceeds this value, install a primary regulator that will reduce it to the correct pressure before it enters the regulator on the plant.

1. Turn on the supply of natural gas or vapor fuel and start the engine.

Instructions for starting various types of plants are given in this section. Refer to the applicable paragraph but do not choke the engine or fill the carburetor with gasoline. The choke plate must be in its wide open position at all times when operating the plant on natural, butane, or propane gas. Be sure it is locked in its open position. Set spark plug gap at 0.018" for most efficient operation on gas fuel.

**NOTE**

The priming button on the regulator may have to be pushed to supply gas to the engine to get it started. Do not hold the button in, touch it lightly to avoid overpriming.

2. Adjust the gas adjustment valve at the air intake to obtain the best operation at the maximum load that will be placed on the plant. Turning the adjusting valve in (clockwise) decreases the amount of vapor to the carburetor, turning the valve out (counterclockwise) increases the amount of vapor to the carburetor. The adjustment procedure should be repeated after the plant has reached normal operating temperature to insure proper adjustment.
3. If the engine speed and generator voltage are unusually high, it will be necessary to adjust the governor spring adjusting nut to get the correct speed and voltage. For further instructions regarding governor adjustment, see GOVERNOR in the ACCESSORY SERVICE section.

The voltage should be slightly above the nameplate rating when there is no load on the plant and slightly below the nameplate rating when there is a full load on the plant, if the governor is properly adjusted.

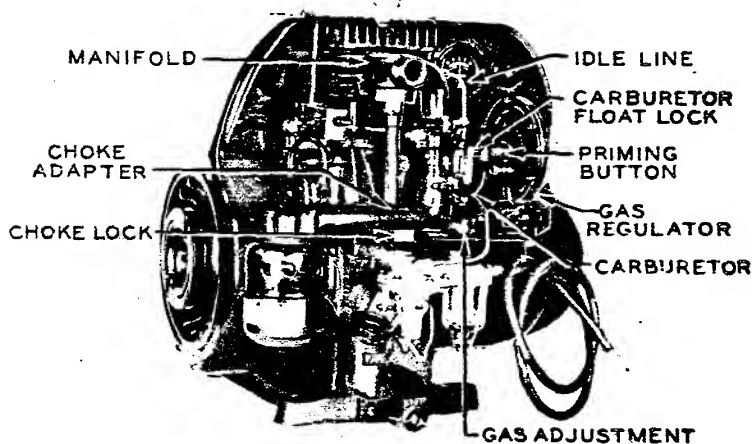
4. Make the final adjustment of the governor and the gas adjustment valve after the plant reaches normal operating temperature.

**GASOLINE OPERATION**

If it becomes necessary or desirable to operate the plant on gasoline, the following steps should be followed.

1. Shut off the natural gas or butane-propane vapor supply.

2. Turn the float stop screw all the way in (clockwise) until it seats.
3. Make sure the choke is free to operate.
4. Open the gasoline shutoff valve.
5. Start the engine, following the applicable instructions given in this section. The carburetor has fixed jets and is therefore not adjustable for gasoline operation. If the engine speed and generator voltage are unsteady, it may be necessary to adjust the governor or to remove and clean the fixed jets and jet passages of the carburetor. To change back to natural gas operation, reverse the above procedure.



VAPOR FUEL ATTACHMENTS

**COLD TEMPERATURES.** - Lubrication and fuel require special attention at temperatures below 0° Fahrenheit or -18° Centigrade.

**LUBRICATION.** - For temperatures below 0°F. (-18°C.) if SAE No. 5 or 5W oil is not available, dilute No. 10W oil with 10% of kerosene. Thoroughly mix 2-1/4 quarts of SAE No. 10W oil with 1/2 pint of kerosene. Fill the crankcase to the proper level. Run the engine for at least ten minutes to thoroughly circulate the mixture through the engine. Never add kerosene alone to the oil already in the crankcase. Do not thin an oil heavier than SAE 10, as the mixture may separate when the engine is stopped.

When adding oil between drain periods, use a mixture of 1/4 pint of kerosene to each quart of oil. Check the oil level at least every 8 hours and change oil every 50 operating hours.

**AIR CLEANER.** - If the plant is equipped with an oil bath air cleaner, and the air passage becomes restricted by frost, or the light oil used in the cleaner (SAE 10W) congeals, remove and clean the cleaner and reassemble without oil, until the temperature conditions will again permit the use of oil.

**FUEL.** - Give special attention to fuel. Fresh, winter grade fuel aids starting. Never fill the tank entirely full with cold gasoline.

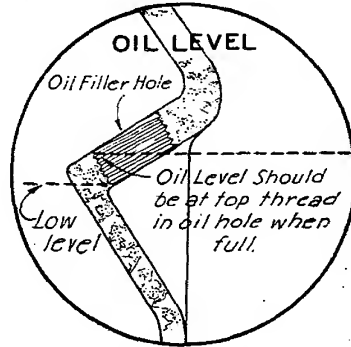
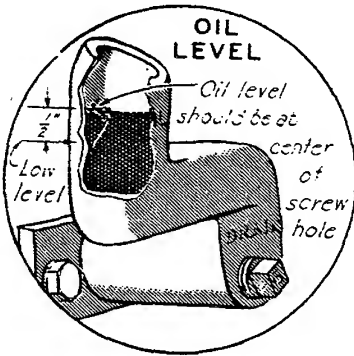
**HOT TEMPERATURES.** - Under extremely warm operating conditions, provide ample ventilation, and keep the crankcase oil level near the top of the oil fill hole. Keep the cooling system clean and unobstructed. Change oil every 100 operating hours.

**VENTILATION.** - The cooling area around the plant must be such that cool air can circulate freely over the plant at all times. The cooling fins on the engine must be kept clean and all air passages kept open.

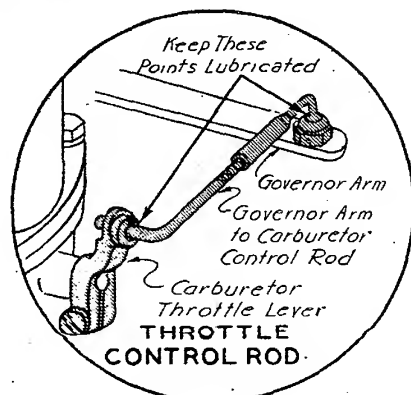
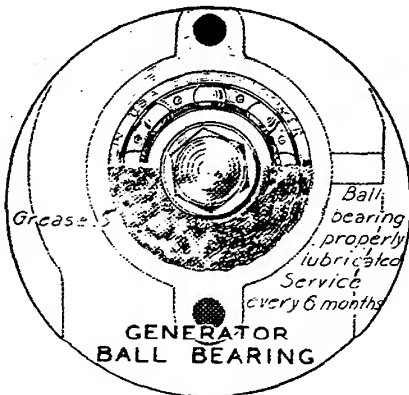
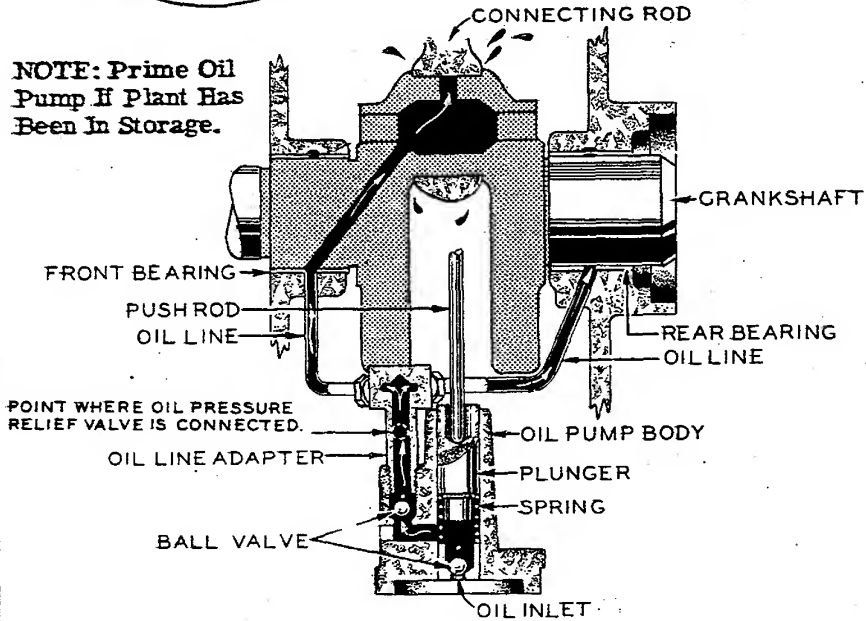
**DUST AND DIRT.** - Keep the plant as clean as practicable. Check the operation often and service as needed. Clean the air cleaner often. Clean the commutator and brushes often and see that the brushes ride freely in their holders. Keep supplies of fuel and oil in airtight containers.

**AUTOMATIC CHOKE.** - To prevent overchoking when temperatures at the plant are below 32°F. (0°C.), it may be necessary to loosen the choke bracket mounting screw and turn the choke assembly in a counterclockwise direction until the wire handle at the bottom of the choke shaft is at right angles to the choke body and there is very little tension on the handle. It may be necessary to correct this

adjustment occasionally as the temperature conditions warrant. Do not lubricate the choke shaft. If it becomes dirty or oily, clean with gasoline or other suitable solvent. When operating conditions return to normal, reset as instructed under Automatic Choke Adjustment in the ACCESSORY SERVICE section.



**NOTE: Prime Oil Pump If Plant Has Been In Storage.**



## LUBRICATION



**PRELIMINARY.** - Follow a definite schedule of inspection and service.

Service periods indicated are for normal service. For extreme conditions of load, temperatures, frequent starts, dust, and dirt, service more often. If the plant is to be operated more than 8 hours a day, check every 8 hours; more than 50 hours a week, check every 50 hours; more than 200 hours a month, check every 200 hours; more than 1200 hours each six months, check every 1200 hours.

### DAILY SERVICE

**FUEL.** - Check the fuel supply. Add proper gasoline as necessary.

**CRANKCASE OIL LEVEL.** - Check the oil level and add oil if needed.

Never operate the engine with the oil below the level indicated in the lubrication illustration.

**CLEANING.** - Keep the engine and generator clean and free of dirt. Remove any excess oil or grease.

### WEEKLY SERVICE

**LUBRICATION.** - Check the oil. Add oil, if necessary. Change oil every 100 operating hours unless the plant is operated with diluted oil or leaded fuels, then change every 50 operating hours.

Lubricate the governor arm ball joint and control rod, using a graphite lubricant or non-gumming machine oil.

**SPARK PLUG.** - Clean and reset the gap between electrodes to .025". If gas fuel is used, keep the gap at 0.018 inch.

**AIR CLEANER.** - Clean the element thoroughly in gasoline or other suitable solvent. Allow to dry or dry by using an air hose. Refill the cup to the level indicated thereon with oil of the same SAE number as used in the crankcase except as noted under abnormal operating conditions. If the air cleaner is the dry type thoroughly clean in gasoline, dry with an air hose then saturate with light oil and allow to thoroughly drain before replacing.

**BATTERIES.** - For plants having batteries, make certain all connections are clean and tight. Keep the electrolyte level above the plates by adding clean distilled water. Do not fill to overflowing. Follow the instructions furnished by the battery manufacturer or supplier regarding proper level.

**GOVERNOR.** - A light non-gumming oil or powdered graphite is recommended on all governor linkages and ball joints.

## MONTHLY SERVICE

**FUEL SEDIMENT BOWL.** - Clean the bowl and screen. Be sure the gasket is in good order before replacing. Inspect for leaks and correct any found.

**CARBURETOR.** - Drain and clean the carburetor bowl. Remove jets and blow out both jet and jet passages with compressed air or clean with a length of fine soft copper wire.

**EXHAUST SYSTEM.** - Inspect all exhaust connections. Tighten or replace all parts requiring it.

**ENGINE COMPRESSION.** - Check the compression of the cylinder by rocking the flywheel with the hands. If the compression is good, a considerable amount of effort will be required to rock the flywheel over the compression strokes. Little effort will be required to rock the flywheel over the compression stroke if the compression is poor. Loss of compression may be due to a leaking spark plug, spark plug gasket, valves, cylinder head gasket, or piston rings. Repair or replace, as needed.

**MAGNETO BREAKER POINTS.** - Contact points can be resurfaced by using a fine stone. If necessary, they may be replaced. After either resurfacing or replacing, adjust the gap to 0.020 inch. If excessive arcing occurs at the breaker points, a defective condenser is indicated and it should be replaced.

**ANTI-FLICKER BREAKER POINTS.** - Anti-flicker breaker points are used only on ac and direct service type plant, and are mounted on the valve inspection plate. The correct adjustment of the breaker point gap is 0.025 inch. Contact points can be resurfaced by using a fine stone. If necessary, they may be replaced. If excessive arcing occurs at the breaker points a defective condenser is indicated and it should be replaced.

**GENERATOR.** - Examine the commutator and brushes. Clean, adjust or replace as needed. Brushes worn to 5/8 inch should be replaced.

**GENERAL.** - Inspect the plant thoroughly for leaks, loose electrical connections, and other external items that may need attention.

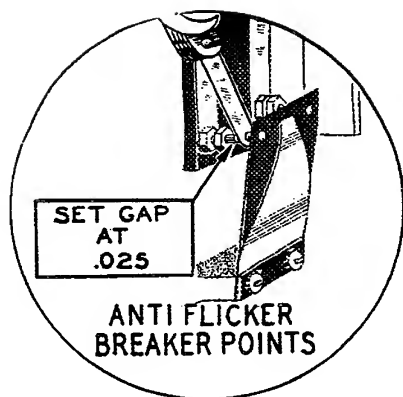
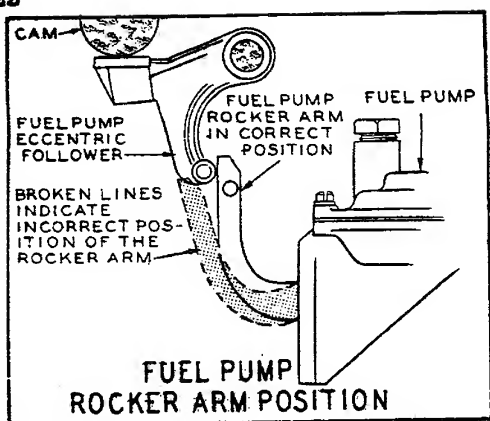
## SEMI-YEARLY SERVICE

Examine the brush rig for proper alignment of the witness mark on the brush rig and generator frame.

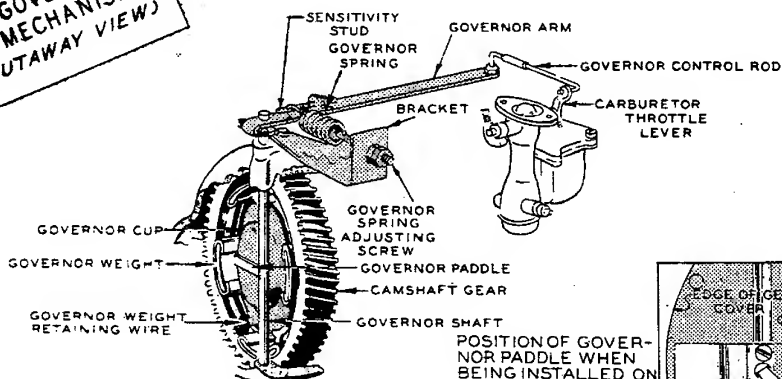
All dirt, oil and grease should be removed from the exterior of the plant. Check the brushes for wear, and make sure they ride freely in the brush holders. Wipe the commutator with a lint free cloth.

The armature of some plants uses a ball bearing at the outer end. The frequency of necessary bearing lubrication will depend upon the type of bearing grease used. If common ball bearing grease is used, lubricate every 6 months. If lithium base grease (meeting military specification MIL-G-1094) is used, lubricate every 2 years or 5000 operating hours. After removing as much as possible of the old grease, refill the bearing. Refill  $\frac{1}{2}$  full if using common bearing grease -  $\frac{1}{4}$  full if using the recommended lithium base (military) grease. Take extreme care to keep dirt out of the bearing.

The oil pump should be removed twice a year and thoroughly cleaned with gasoline. Be sure the screen is clean and free of all dirt. Dry with compressed air if possible. Place the pump in a pan of clean oil (about half submerged) and work the plunger by hand, until the oil flows freely from the outlets. Thoroughly clean and dry the oil base before replacing. Install a new oil base gasket.

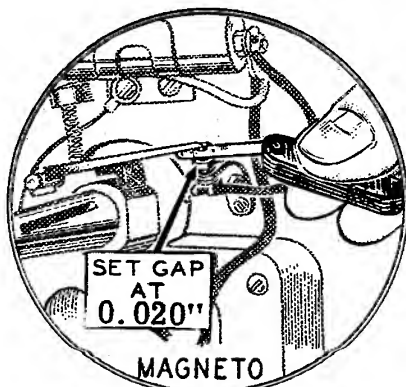
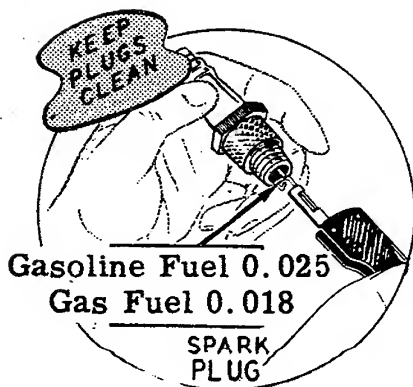
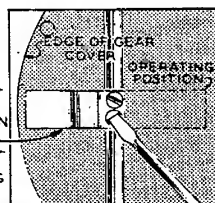


GOVERNOR MECHANISM (CUTAWAY VIEW)



POSITION OF GOVERNOR PADDLE WHEN BEING INSTALLED ON SHAFT.

SEE INSTRUCTIONS UNDER MAINTENANCE AND REPAIR FOR INSTALLING GEAR COVER



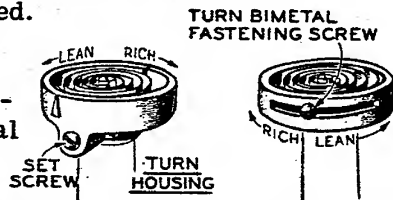
ACCESSORY SERVICE

**GENERAL.** - This section includes instructions for certain adjustments which are not of an accessory nature but which the operator should be able to make when needed. If trouble develops refer to section on "Service Diagnosis".

**CARBURETOR.** - The carburetor requires little care or attention. It is of the fixed jet type, therefore it requires no adjusting. The jets may be removed for cleaning or replacement. Foreign particles or moisture may get through the gas filter and screen and lodge in the tiny holes of the jets, this causes hard starting and poor operation. Refer to "Monthly Service" section for details on cleaning carburetor.

**AUTOMATIC CHOKE ADJUSTMENT.** - To adjust the choke, loosen the bimetal housing screw or the bimetal fastening screw, as illustrated.

Turn the housing or the fastening screw as necessary and retighten. If a new bimetal is installed, be sure to note the original counterclockwise direction of spiral inward from the fastening screw. If the direction of spiral is reversed, choking action as the plant warms up will be increased, soon causing the plant to stop. The pin at the bottom indicates the choke plate position.



**FUEL PUMP.** - An automotive type fuel pump is used on some models.

If fuel does not reach the carburetor, after working the pump primer lever eight to ten strokes, check the fuel shutoff, the fuel supply, and the strainer before dismantling the pump. Check the pump by disconnecting the fuel line at the carburetor and working the primer lever. If there is enough fuel in the tank, and the line between the tank and pump is unobstructed, but the pump will not operate, repair or replace it. A faulty pump is usually due to a leaky diaphragm, valve, or gasket; weak or broken spring; or wear in the linkage.

**GOVERNOR ADJUSTMENT.** - Proper governor adjustment is essential for good plant operation. There must be no drag or binding in any part of the governor or throttle mechanism that will retard free operation. To adjust the governor, loosen the clamp screw holding the governor arm on the governor shaft. With the governor spring holding the arm in the open throttle position, insert a screwdriver in the slot at the top end of the shaft and turn the shaft to the right (clockwise) as far as possible, hold firmly in this position and tighten the lock screw securely. Do not force the arm down on the shaft so far as to cause the arm to bind on the gearcase. Move the arm in towards the cylinder and note if the spring snaps it back to its wide open position. The speed and therefore the voltage of the generator can be adjusted by turning the adjusting nut to the right (clockwise) to increase

the speed, or to the left (counterclockwise) to decrease the speed. Check the governor arm periodically to assure freedom of action.

**HUNTING PREVENTION.** - Should the plant develop a hunting condition (alternately increasing and decreasing speed) it may be corrected by changing the adjustment of the governor in the following manner. Loosen the governor arm clamp screw holding the arm on the shaft. Insert a screwdriver in the slot in the top of the shaft and turn the shaft clockwise as far as possible. Hold the shaft in this position. Push the governor arm in towards the cylinder as far as possible. Hold in this position and tighten the clamp screw just enough to have a slight drag on the shaft. Pull the governor arm out, away from the cylinder as far as possible and tighten the clamp screw securely.

The fulcrum or sensitivity adjusting screw on the governor arm is only adjusted if other adjustments do not provide satisfactory performance. Turning the screw clockwise decreases the sensitivity and counterclockwise increases it. Regulation is better with the inner end of the spring closest to the shaft, but the tendency to hunt is increased. Decreasing the sensitivity slightly may correct this condition. Always adjust the speed of the plant after making governor adjustments and the plant has reached normal operating temperature.

**SPARK PLUG.** - Clean the spark plug with a wire brush or in a regular plug cleaning machine. Reset the gap to 0.025 inch for gasoline operation, or 0.018 inch for gas operation. If defective, replace with a new plug - Champion 6M or equivalent.

**FUEL PUMP SEDIMENT BOWL.** - Remove the sediment bowl and the screen. Clean thoroughly and replace, making sure the bowl top surface is not chipped and that its gasket is in good condition.

**OIL PUMP.** - If the oil pump is removed, or one of the oil lines disconnected when servicing the plant, be sure to prime the oil pump before operating the plant. Fill the oil pump body with oil. After properly filling the crankcase with oil, insert a screwdriver through the valve inspection plate opening and manually operate the oil pump cam follower until increased pressure indicates the oil pump is properly primed.

**GENERAL.** - All major repairs should be made by a competent mechanic who is thoroughly familiar with the operation of a modern internal combustion type engine. Refer to the Service Diagnosis section for assistance in locating and correcting troubles which may occur. Maintain factory limits and clearances as listed in the Table of Clearances in this section.

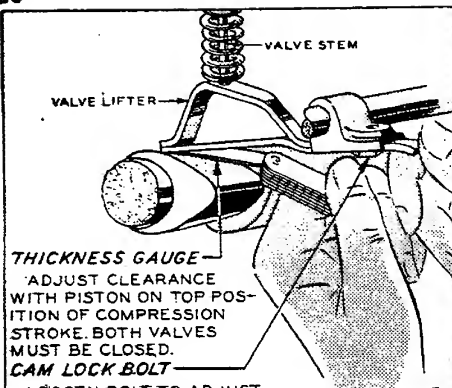
## ENGINE

**CRANKCASE INSPECTION.** - A competent mechanic can determine the need for major repairs by removing the crankcase inspection plate and examining the working parts for excessive wear.

**VALVE SERVICE.** - Compression readings for the cylinder should be 75 to 80 pounds when cranked electrically, and 60 to 65 pounds hand cranked. All readings are for approximate sea level. Readings slightly lower for higher altitudes. Clean the valves and the combustion chamber of all carbon. Note the condition of the valves and seats. Valves should be  $44^{\circ}$ , and valve seats should be ground  $45^{\circ}$ . Use a fine grade of valve grinding compound to lightly touch up the valve and seat. The correct width of the seat should be between  $3/64$  and  $1/16$  of an inch wide. Clean compound from the valves and seats. Lubricate the valve stems and guides freely with light oil. Be sure the valves drop of their own weight in their respective guides before assembling.

**PISTON RING SERVICE.** - The aluminum piston has three compression rings and one oil control ring. If there is any doubt about the serviceability of the old piston rings, install new ones. Fit each ring individually to the cylinder from the crankcase end. The correct gap of the ring when properly fitted to the cylinder is 0.010 to 0.015 of an inch. If the ring is not too large, the ends may be filed slightly to the correct gap clearance. Thoroughly clean the carbon from the ring grooves so new ring will roll freely in the grooves completely around the piston. Tapered type rings will be marked "Top" or identified in some other manner, this mark must be placed toward the top of the piston. Space the ring gaps at equal distance  $1/4$  of the way around the piston one gap from the other.

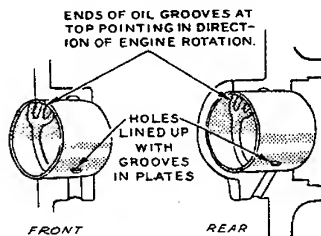
**CONNECTING ROD.** - The aluminum alloy connecting rod and its bearing cap have reference marks which must coincide. These marks must face toward the camshaft. The connecting rod bearing clearance to the crankshaft may be reduced as necessary by carefully dressing the cap on a sheet of abrasive cloth laid on a surface plate. Upon reassembly to the engine, be sure the connecting rod and piston assembly is properly aligned. Misalignment will cause rapid engine wear. Tighten connecting rod bolts to 17 to 20 lbs. ft. torque.



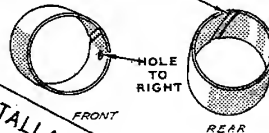
**THICKNESS GAUGE**—ADJUST CLEARANCE WITH PISTON ON TOP POSITION OF COMPRESSION STROKE. BOTH VALVES MUST BE CLOSED.

**CAM LOCK BOLT**—LOOSEN BOLT TO ADJUST. TO INCREASE—PUSH IN. TO DECREASE—PULL OUT. LOCK SECURELY.

**VALVE LIFTER ADJUSTMENT**

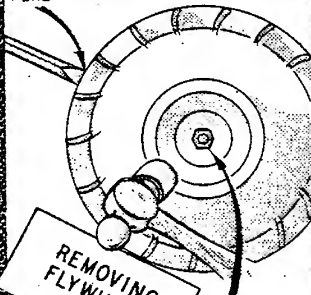


OIL GROOVE CENTERED AT TOP



**INSTALLATION OF BEARINGS**

SCREWDRIVER INSERTED HERE

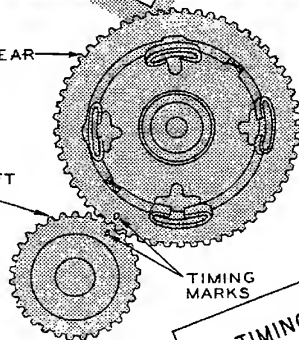


**REMOVING FLYWHEEL**

STRIKE HAMMER BLOW HERE

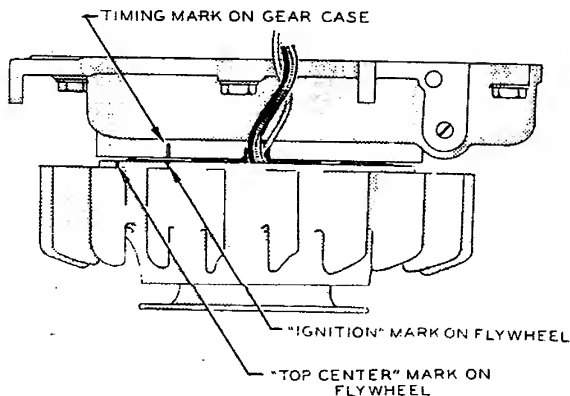
CAMSHAFT GEAR

CRANKSHAFT GEAR



**TIMING GEAR MARKS**

**IGNITION TIMING MARKS**



## MAINTENANCE AND REPAIR—ENGINE



**VALVE LIFTER ADJUSTMENT.** - Remove the tappet inspection and anti-flicker breaker point cover behind the carburetor. Revolve the crankshaft until the intake valve opens and closes and the piston is at the extreme top of the cylinder. (This is the correct position to make adjustment of the valves). Loosen the valve lifter lock screw to make the adjustment. Pushing in on the valve lifter increases the clearance between the valve lifter and the cam. Pulling out on the valve lifter decreases the clearance between the valve lifter and the cam. The correct clearance for the intake valve is 0.008 to 0.010 inch and the correct clearance for the exhaust valve is 0.010 to 0.012 inch when the engine is cold. In each case the thinner feeler gauge should pass freely between the valve lifter and the cam surface but the thicker feeler gauge should not. Tighten the valve lifter lock screw securely, after completing the valve adjustment.

**FLYWHEEL.** - Remove the blower housing, loosen the hexagon nut at the center of the flywheel hub until it is flush with the end of the threads. Insert a heavy screwdriver between the flywheel and the crankcase. Pull outward on the screwdriver and at the same time strike the end of the stud a sharp endwise blow with a hammer to loosen the flywheel. When reassembling tighten the flywheel stud nut 35 to 40 lbs. ft. when using a torque wrench.

**CRANKSHAFT GEAR.** - A steel gear is pressed on the crankshaft and is held in place with a large retaining nut. It may be removed by use of a gear puller after first removing the retaining nut. Use care in applying the puller as damage to the teeth may result.

**CAMSHAFT GEAR.** - Remove the cast iron camshaft gear and camshaft as an assembly, sliding it out while raising the valve lifters so they will clear the cams and rear journal. Except on battery charging plants, it will also be necessary to remove the anti-flicker breaker plate and its plunger. Use an arbor press to remove and replace the gear.

**CYLINDERS.** - If the cylinder walls are worn more than 0.005 inch out of true, it is advisable to install a new cylinder block with new standard piston and piston rings or to refinish the cylinder to accommodate a new piston of one of the available oversizes. Pistons are available in 0.010 inch, .020 inch and .030 inch oversize.

**BEARINGS.** - The main bearings and the camshaft bearings, are steel backed, babbitt lined. They are pressed into the crankcase and the bearing plate and are then line reamed. When the bearing has a hole, be sure it is lined up with the corresponding hole in the crankcase or bearing plate. The correct clearance for the crankshaft bearings is 0.002 to 0.003 of an inch, the correct clearance for the camshaft bearings is 0.0015 to 0.0025 of an inch.

**OIL PRESSURE RELIEF VALVE.** - A by-pass valve in the oil pressure line controls the amount of oil delivered to the main bearings and connecting rod. This valve is properly set at the factory to maintain the correct oil pressure within the plant. This adjustment should not be disturbed. If for any reason the adjustment of the valve has been changed, a new by-pass valve assembly should be installed. Any change in the adjustment other than a factory setting might cause serious trouble.

**OIL SEALS.** - The rear main bearing oil seal is pressed into the crankcase. This seal must be replaced whenever a major overhaul is made, or whenever oil leakage occurs from the rear main bearing, which is evidenced by oil being thrown from the ventilating openings between the engine and generator.

When installing a new seal, grease the shaft, use care in slipping the seal over the shaft so that the leather lip will not be damaged. Tap the seal evenly into place and shellac the surface.

The cork oil seal in the gearcase is cemented into the casting. This should be allowed to thoroughly dry before assembling the case to the engine. Replace this seal when overhauling the plant or when leakage occurs at the seal.

**GOVERNOR ARM.** - When replacing the governor arm, be sure that the carburetor end is approximately level with the throttle lever. Do not tighten the governor arm clamp screw until the control rod from the governor arm to the throttle arm has been installed in the throttle arm. Do not force the arm down on the shaft so far as to cause a binding condition. Then, with the governor spring holding the arm in the open-throttle position insert a screwdriver into the slot at the top end of the shaft and turn the shaft clockwise as far as it will go. Hold in this position and tighten securely. After the engine reaches normal operating temperature, adjust the engine speed to the speed given on the plant nameplate.

**IGNITION SYSTEM.** - Ignition current is supplied by a high tension fly-wheel type magneto. It produces a high output voltage at a low cranking speed. The entire ignition system is radio shielded. Refer to Periodic Service and Accessory Service for instructions on servicing.

**TIMING THE IGNITION.** - The marks on the timing gears must coincide. Revolve the crankshaft clockwise until the intake valve opens and closes and the piston is at the extreme top of the cylinder. Remove the flywheel and check the magneto breaker point gap. To obtain the proper setting of the breaker points, slightly loosen the two screws that hold the stationary point bracket to the magneto backplate, and slide the bracket up or down for the proper clearance of .020

inch. The two screws holding the magneto backplate assembly to the gear cover are now slightly loosened to permit shifting of the backplate assembly. Shifting the assembly clockwise or with the rotation of the engine retards the spark timing. Shifting the assembly counterclockwise or against rotation advances the spark timing. A low voltage, series timing light is used to obtain the exact timing. Disconnect the coil lead from the condenser terminal. Connect one lead from the timing light to the stop wire and the other lead to a good ground on the engine. Place the flywheel loosely on the crankshaft and rotate clockwise. The light will go out when the points separate, this is also the point that the spark occurs at the spark plug when the engine is running. If the light goes out before the 25° timing mark on the flywheel aligns with the timing mark on the gear cover, shift the backplate clockwise to retard the timing. If the light goes out after the 25° flywheel timing mark aligns with the timing mark on the gear cover, shift the backplate counterclockwise to advance timing.

Tighten the backplate screws and then recheck, to make sure that the backplate assembly position is correct. The timing light should go out at exactly the time that the 25° timing mark on the flywheel and the timing mark on the gear cover align, when the flywheel is rotated clockwise. Replace the coil lead and tighten the screw. Replace the flywheel, lockwasher and nut, tighten nut 35 to 40 lbs. ft. when using a torque wrench.

**MAGNETO.** - Remove the blower housing and flywheel to service the magneto. Check the breaker points and if pitted or burned too badly to resurface with a small carborundum hone, replace with a complete new set. In either case the points must meet square and even. After conditioning the points or installing new points always adjust the gap to 0.020 of an inch. Check the spring tension of the contact arm. The correct tension is approximately 23 ounces. A small amount of adhesive or clinging type lubricant packed on the inner angle of the rubbing block is sufficient.

**TESTING THE SPARK.** - Remove the spark plug shield. Disconnect the spark plug cable from the spark plug. Hold this end about 3/16 inch from the base of the spark plug or the cylinder head. Crank the engine either electrically or manually and note whether the spark jumps the 3/16 inch gap. If the spark fails to jump the gap, check the magneto breaker points and the magneto coil.

**CONDENSER.** - A defective condenser produces a weak, yellow spark, thereby resulting in the ignition points becoming pitted and burned. Replace any defective condenser and burned points. When a new condenser is required, replace with one of proper capacity.

**COIL.** - The coil and core assembly should not be disturbed unless it is to install a new coil. When installing a new coil and core assembly, make sure that the core clears the magneto within the flywheel.

Too great a clearance produces a weak spark. The correct clearance is 0.007 to 0.010 of an inch.

TABLE OF CLEARANCES

	MINIMUM	MAXIMUM
Valve Clearance (Intake) .....	0.008"	0.010"
Valve Clearance (Exhaust) .....	0.010"	0.012"
Valve Seat Width .....	3/64"	1/16"
Valve Stem Clearance in Guide (All) ..	0.002"	0.0035"
Crankshaft Main Bearing .....	0.002"	0.003"
Crankshaft End Play .....	0.006"	0.008"
Connecting Rod Bearing .....	0.0025"	0.0035"
Connecting Rod End Play .....	0.004"	0.006"
Camshaft Bearing .....	0.0015"	0.0025"
Timing Gear Backlash .....	0.003"	0.005"
Piston (Clearance in Cylinder) .....	0.006"	0.0075"
Piston Pin (In Piston) .....	Hand Push Fit	
Piston Pin (In Connecting Rod) .....	Thumb Push Fit	
Piston Ring Gap (In Cylinder) .....	0.010"	0.015"
Piston Ring to Groove (Clearance) ...	0.001"	0.0015"
Cylinder Bore (Actual Diameter) ....	2.7495"	2.7505"
Magneto Breaker Points .....	.020"	
Anti-Flicker Breaker Points .....	.025"	
Spark Plug - Gasoline Fuel .....	.025"	
Gaseous Fuel .....	.018"	

### GENERATOR

**GENERAL.** - The generator normally requires little servicing other than periodic attention to the brushes and commutator.

**ARMATURE.** - The armature shaft has a taper at one end which fits into the internal taper in the crankshaft. It is held in place by a stud which passes through the armature shaft. A nut and washer at the outer end hold it securely. If the armature has been removed and is reassembled or a new armature is installed, the run-out at the outer end should not vary more than 0.003". Any run-out more than that may be due to dirt between tapers or a nick on the taper surfaces. This condition must be corrected.

**COMMUTATOR.** - When the commutator becomes grooved, out of round or the surface becomes pitted or rough so that good brush seating cannot be maintained, it will be necessary to remove the armature and to refinish it in a lathe. Undercut the mica 1/32 of an inch after turning down the commutator. Avoid injury to the commutator bars. Leave no burrs along the edges of the bars.

**COLLECTOR RINGS.** - The collector rings may become pitted from the flashing or arcing of the a c brushes or by the brushes sticking in their guides. They should be cleaned and sanded, or if badly burned, refaced in a lathe.

**TESTING WINDINGS.** - A test lamp set or an armature growler is required for the various tests. Before making any tests, lift all brushes in their holders and disconnect the load wires. Test prods must make good electrical connections at points of contact. If the armature winding tests open-circuited, short-circuited, or grounded, the practical repair is to install a new one. To test for open or short circuits, use an armature growler and follow the manufacturer's instructions. To test for a ground, use a test lamp.

If the field winding tests open-circuited, short-circuited, or grounded, the practical repair is to install new field coils unless the trouble is in the leads outside the winding proper.

### CONTROLS

**CONTROL PANEL EQUIPMENT.** - If any of the control panel equipment fails to function properly, it should be replaced by a corresponding new unit, rather than to attempt repairs on the old one. No attempt should be made to repair such units as meters, fuses, switches, and receptacles. Check all electrical connections and contacts, clean and tighten if necessary. Be sure the battery is disconnected when making this service.



## POSSIBLE CAUSE

## REMEDY

## ENGINE CRANKS TOO STIFFLY

Too heavy oil in crankcase.      Drain, refill with lighter oil.

Engine.      Disassemble and repair.

## ENGINE WILL NOT START WHEN CRANKED

Faulty ignition.      Clean, adjust, or replace breaker points, plug, condenser, etc., or re-time magneto.

Lack of fuel or faulty carburetion.      Refill the tank. Check the fuel system. Clean, adjust or replace parts necessary.

Clogged fuel screen.      Clean.

Cylinder flooded.      Crank few times with spark plug removed.

Poor fuel.      Drain, refill with good fuel.

Poor compression.      Tighten cylinder head and spark plug. If still not corrected, grind the valves. Replace piston rings, if necessary.

Wrong timing.      Readjust magneto backplate.

## ENGINE RUNS BUT VOLTAGE DOES NOT BUILD UP

Poor commutation.      See that brushes seat well on commutator, are free in holders, are not worn shorter than 5/8 inch, and have good spring tension.

Open circuit, short circuit, or ground in generator.      See GENERATOR, replace part necessary.

## VOLTAGE UNSTEADY BUT ENGINE NOT MISFIRING

Speed too low.      Adjust governor to correct speed.

Poor commutation or brush contact.      See that brushes seat well on commutator, are free in holders, are not worn shorter than 5/8 inch, and have good spring tension.

## POSSIBLE CAUSE

## REMEDY

## VOLTAGE UNSTEADY BUT ENGINE NOT MISFIRING (Cont.)

Loose connections.	Tighten connections.
Fluctuating load.	Correct any abnormal load condition causing trouble.

## GENERATOR OVERHEATING

Overloaded.	Reduce load.
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## VOLTAGE DROPS UNDER HEAVY LOAD

Engine lacks power.	See remedies for engine missing under heavy load.
Poor compression.	Tighten cylinder head and spark plug. If still not corrected, grind the valves. Replace piston rings, if necessary.
Faulty carburetion.	Check the fuel system. Clean, adjust or replace parts necessary.
Carburetor air cleaner.	Clean.
Choke.	See that it opens wide enough.
Carbon in cylinder.	Remove carbon.
Restricted exhaust line.	Clean or increase the size.

## ENGINE MISFIRES AT LIGHT LOAD

Carburetor adjustment set wrong or clogged.	Adjust, clean if needed.
Spark plug gap too narrow.	Adjust to correct gap.
Intake air leak.	Tighten or replace gaskets.
Faulty ignition.	Clean, adjust, or replace breaker points, plug, condenser, etc.
Poor compression.	Tighten cylinder head and spark plugs. If still not corrected, grind valves. Replace piston rings, if necessary.

## POSSIBLE CAUSE

## REMEDY

## ENGINE MISFIRES AT HEAVY LOAD

Spark plug defective.	Replace.
Faulty ignition.	Clean, adjust, or replace breaker points, plug, condenser, etc.
Clogged carburetor.	Clean jets.
Clogged fuel screen.	Clean.
Defective spark plug cable.	Replace.

## ENGINE MISFIRES AT ALL SPEEDS

Fouled spark plug.	Clean and adjust.
Defective or wrong spark plug.	Replace.
Sticking valves.	Grind, or replace.
Broken valve spring.	Replace.
Defective ignition wires.	Replace.
Defective or improperly adjusted points.	Adjust or replace breaker points.

## ENGINE LOW ON POWER

Oil too light.	Drain, refill with proper oil.
Oil badly diluted.	Drain, refill with proper oil.
Oil too low.	Add oil.
Badly worn engine.	Repair.
Carbon or lead deposits.	Remove and clean.
Valves leaking.	Grind or replace.

## ENGINE BACKFIRES AT CARBURETOR

Lean fuel mixture.	Clean or adjust carburetor.
Clogged fuel screen.	Clean screen.



## POSSIBLE CAUSE

## REMEDY

## ENGINE BACKFIRES AT CARBURETOR (Cont.)

Air leaks at intake manifold.	Replace gaskets, tighten.
Poor fuel.	Refill with good, fresh fuel.
Spark too late.	Readjust magneto backplate.
Intake valves leaking.	Grind or replace.

## EXCESSIVE OIL CONSUMPTION, LIGHT BLUE SMOKY EXHAUST

Poor compression, usually due to leaking valves.	Tighten cylinder head and plug. If still not corrected, grind or replace valves.
Oil leaks from oil base or connections. This does not cause smoky exhaust.	Replace gaskets and leaking tubing. Tighten screws and connections.
Oil too light or diluted.	Drain, refill with correct oil.
Too large bearing clearance.	Replace.
Engine misfires.	Refer to section "Engine Misfires at All Speeds".
Faulty ignition.	Clean, adjust, or replace breaker points, plugs, condenser, etc.
Unit operated at light or no load for long periods.	No remedy needed.
Too much oil.	Drain excess oil.

## BLACK, SMOKY EXHAUST, EXCESSIVE FUEL CONSUMPTION, FOULING OF SPARK PLUG WITH BLACK SOOT, POSSIBLE LACK OF POWER UNDER HEAVY LOAD

Fuel mixture too rich.	Adjust carburetor or choke. Install needed carburetor parts, adjust float level.
Choke not open.	See that choke opens properly.
Dirty air cleaner.	Clean, refill to proper level.

## POSSIBLE CAUSE

## REMEDY

## LIGHT POUNDING KNOCK

Loose connecting rod bearing.      Adjust or replace.

Low oil supply.      Add oil.

Oil badly diluted.      Change oil.

## ENGINE STOPS UNEXPECTEDLY

Fuel tank empty.      Refill.

Defective ignition.      Check the ignition system. Repair or replace parts necessary.

DULL METALLIC THUD. IF NOT BAD, MAY DISAPPEAR  
AFTER FEW MINUTES OPERATION. IF BAD, INCREASES  
WITH LOAD

Loose crankshaft.      Replace, unless one of the next two remedies permanently correct the trouble.

SHARP METALLIC THUD, ESPECIALLY WHEN COLD ENGINE  
FIRST STARTED

Low oil supply.      Add oil.

Oil badly diluted.      Change oil.

PINGING SOUND WHEN      RAPIDLY ACCELERATED OR HEAVILY  
LOADED

Carbon in cylinders.      Remove carbon.

Spark too early.      Readjust magneto backplate.

Wrong spark plug.      Install correct spark plug.

Spark plug burned or carboned.      Install new plug.

Valves hot.      Adjust tappet clearance.

Fuel stale or low octane.      Use good fresh fuel.

Lean fuel mixture.      Clean and adjust carburetor.

## POSSIBLE CAUSE

## REMEDY

## TAPPING SOUND

Tappet clearance too great.	Adjust or replace tappets.
Broken valve spring.	Install new spring.

## HOLLOW CLICKING SOUND WITH COOL ENGINE UNDER LOAD

Loose piston.	If noise only slight and disappears when engine warms up, no immediate attention needed. Otherwise replace worn parts.
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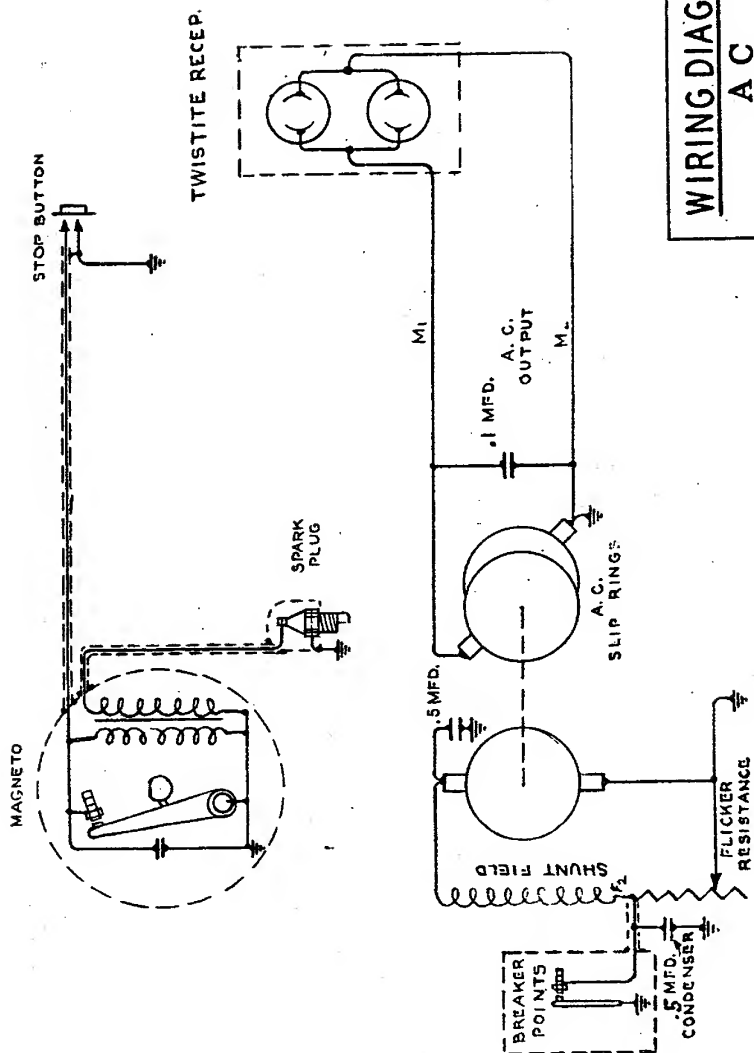
## LIGHT DIM AT FAR END OF LINE BUT BRIGHT NEAR PLANT

Too small line wire for load and distance.	Install larger or extra wires or reduce load.
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MOTORS RUN TOO SLOWLY AND OVERHEAT AT FAR END OF LINE  
BUT OK NEAR POWER UNIT

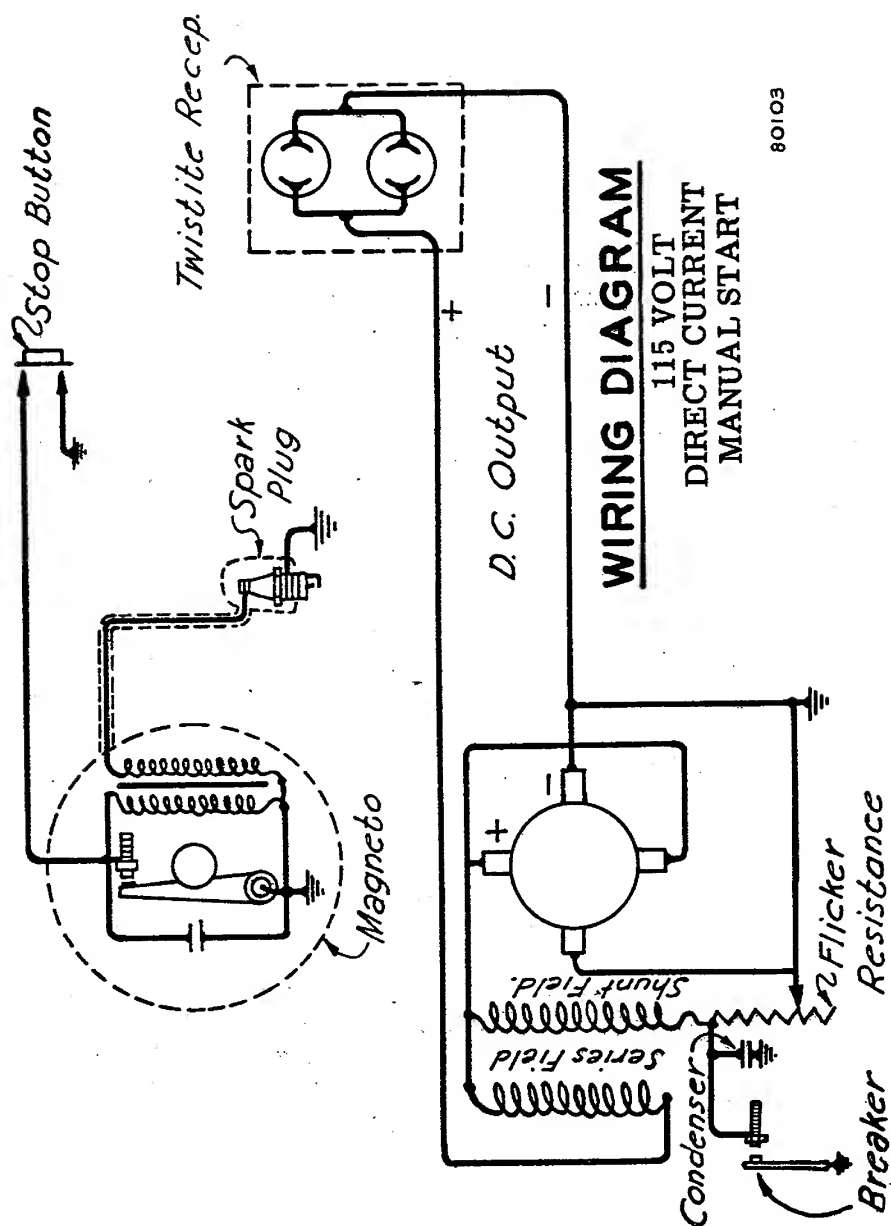
Too small line wire for load and distance.	Install larger or extra wires, or reduce load.
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# WIRING DIAGRAM A C MANUAL START PLANT

80102

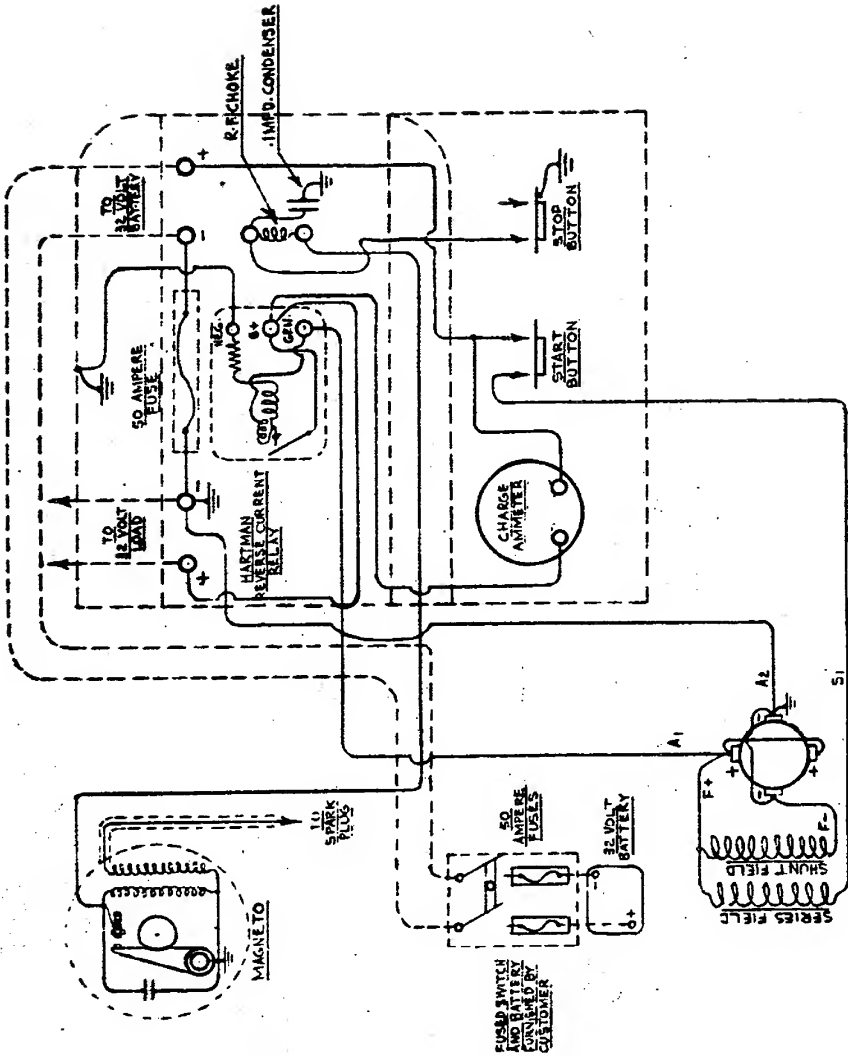


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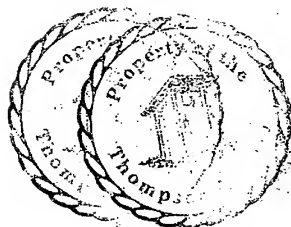
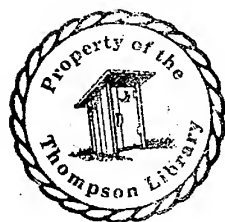
# DIRECT CURRENT 32 VOLT ELECTRIC START WIRING DIAGRAM

60589











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